DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 3400
Classical Game Theory
Fall 2018

Instructor: Melissa Huggan (Melissa.Huggan@Dal.ca) **Office:** Chase 328

Lectures: M W F 10:35-11:25 (04-SEP-2018 - 30-NOV-2018), Sir James Dunn 302
M T 10:35-11:25 (03-DEC-2018 - 04-DEC-2018), Sir James Dunn 302

Course Description

This course will cover the important concepts of classical game theory: game trees, dominance, zero-sum games, saddle points, utility theory, non-zero sum games, Nash equilibrium, non-competitive solutions, Prisoner's dilemma, Chicken, Newcomb's problem. There will be applications to many areas including anthropology, biology, business, economics, and philosophy.

Course Prerequisites

MATH 1030.03 or 2030.03, or permission of the instructor.

Course Objectives/Learning Outcomes

Objective 1: Given the description of a conflict between two people in which both make a simultaneous move and payoffs are between the two people, the student will be able to formulate the strategies and build the payoff matrix associated with them.

Objective 2: Given a 2×2, $2 \times n$, or $n \times 2$ zero-sum matrix game, the student will be able to compute the expected value of the game.

Objective 3: Given a 2×2, $2 \times n$, or $n \times 2$ zero-sum matrix game, the student will be able to compute the best response strategies.

Objective 4: Given an $m \times n$ zero-sum matrix game, the student will be able to compute the upper and lower bounds on the expected value and identify a saddle point if one exists.

Objective 5: Given an $m \times n$ zero-sum matrix game, the student will be able to compute the expected value of the game (with the aid of specialized software).

Objective 6: Given the description of a conflict between two people in which both make a simultaneous move and payoffs are between the two people, the student will be able to verify if a proposed solution is correct.

Objective 7: The student will be able to recall the definition of a Nash Equilibrium.

Objective 8: Given the description of a conflict between two people in which both make a simultaneous move but the payoffs are not necessarily between two people, the student will be able to formulate the strategies and build the payoff bimatrix associated with them.

Objective 9: Given a 2×2 bimatrix game, the student will be able to determine the best response strategies.

Objective 10: Given a 2×2 bimatrix game, the student will be able to select the Nash Equilibria points.

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Objective 11: Given a game tree, the student will be able to identify optimal strategies.

Objective 12: Given simple economic models, the student will be able to select the best course of action using the best-response strategies.

Objective 13: Given an N-player cooperative game, the student will be able to determine the Characteristic function.

Objective 14: Given an N-player cooperative game, the student will be able to determine the allocation of the payoff using the Characteristic function.

Objective 15: Given a 2-player Bargaining Game the student will be able to identify the security points of the players.

Objective 16: The student will be able to recall the definition of an Evolutionary Stable Strategy.

Objective 17: Given a 2×2 population game, the student will be able to determine all Evolutionary Stable Strategies.

Objective 18: Given a 2×2 population game and the associated Evolutionary Stable Strategies, the student will be able to assess the future trends of the size of the sub-populations.

Course Materials

- Recommended textbook: E.N. Barron, Game Theory: An Introduction, 2nd Edition.
- Website: Brightspace

Office Hours The instructor is there to help you! Office hours are set up to give students a time slot to ask their instructor questions. Also, if you cannot attend the scheduled office hours, please email the instructor to set up an alternate time to meet.

Other course requirements

- There are assigned readings for the course which are posted on Brightspace.
- Assignments will be posted on Brightspace. All assignments are equally weighted. Assignments are set up to help students stay on track with the course material as well as frequently assess their understanding.
- All in-class tests/exams are closed book and to be done individually. Only writing utensils are permitted (no calculators).

Course Assessment

Component	**Weight (% of final grade)**	**Date**
Test 1 (in-class)	15%	Oct 3
Test 2 (in-class)	15%	Nov 2
Final Exam (in-class)	25%	Dec 4
Final Exam (take-home)	20%	Dec 4-14
Assignments	25%	(∼5 throughout the term)

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+: (90–100)	A: (85–89)	A-: (80–84)
B+: (77–79)	B: (73–76)	B-: (70–72)
C+: (65–69)	C: (60–64)	C-: (55–59)
D: (50–54)	F: (<50)	

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Course Policies

- Late assignments will not be accepted.
- There will be no make-up tests/exams. If you miss a test without prior permission, then it will count as a zero. Exceptions are made in two cases: (i) if you obtain the instructor's prior permission to miss a test, or (ii) if you miss a test for a medical reason and have a doctor's note (you must notify the instructor prior to the test and provide a medical note upon your return). In these cases, the weight of the missed in-class test will be shifted to the in-class portion of the final exam.
- The final exam will not be rescheduled for personal travel plans. Please be aware of this when booking flights or other travel.
- If someone will be away representing Dalhousie, please let me know and we will explore alternatives.
- Information about the course may be given during class. It is the responsibility of the students to ensure that they are made aware of what occurs during classes.
- No recordings of the class are permitted without instructor approval.

Course Content

1. Zero-sum Games
   (a) 2-person matrix games.
   (b) Strategy concepts: pure, mixed.
   (c) Solution concepts: optimal, dominated and best response strategies; saddle-points; elimination of dominated options.
   (d) Graphical solutions for 2×2, $2 \times n$, $n \times 2$ games.
   (e) Matrix Games and Linear Programming.
2. Nash Equilibrium, in general.
3. 2-person, Non-Zero Sum Games.
   (a) 2×2 bimatrix games: best response, equality of payoffs.
   (b) Rational Reaction Sets.
   (c) Interior Nash Points using Calculus.
   (d) Choosing between Nash Equilibria.
4. Sequential Games
   (a) Game trees.
   (b) Backwards Induction.
   (c) Trembling Hand and Sub-game Perfect Equilibrium.
5. N-Person, Non-Zero Sum Games
   (a) Economic Applications
   (b) Cooperative Games: Characteristic functions; Core; Nucleolus; Shapley value.
   (c) Bargaining: security points.
6. Evolutionary Stable Strategies and Population Games
   (a) Properties of an ESS.
   (b) Examples of Population Games.

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Faculty of Science Course Syllabus (Section B)

MATH 3400

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

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Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/academic-advising.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca/

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: https://dsu.ca/dsas

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html